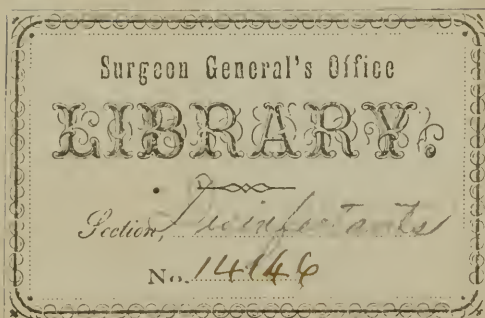


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FACTS
REGARDING THE DISINFECTING POWERS

OF

CHLORINE;

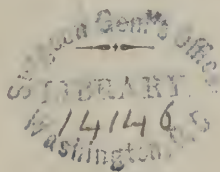
WITH AN EXPLANATION OF THE MODE IN WHICH IT OPERATES,
AND WITH DIRECTIONS HOW IT SHOULD BE APPLIED
FOR DISINFECTING PURPOSES :

IN A LETTER FROM

CHESTER AVERILL, A. M.

TO THE

HON. JOHN I. DEGRAFF,
MAYOR OF THE CITY OF SCHENECTADY.



Schenectady :

S. S. RIGGS PRINTER, NO. 70, UNION-STREET.

.....
1832.



CITY OF SCHENECTADY, July 3, 1832.

CHESTER AVERILL, Esq.

Dear Sir,

I perceive by the public papers that some doubts have been expressed respecting the disinfecting power of the Chloride of Lime.—At the present juncture, this question is evidently one of the highest interest. I beg leave, therefore, presuming that your professional pursuits have led you to investigate the subject, to request, that if consistent with your engagements you will furnish for the benefit of the public, any facts pertaining to this question which may be in your possession.

I am, dear sir, very respectfully,

Yours, &c.

JOHN I. DE GRAFF, *Mayor.*

UNION-COLLEGE, July 4, 1832.

*To the HON. JOHN I. DE GRAFF, Mayor
of the City of Schenectady :*

Dear Sir,

THE present state of the public mind and of the public health, admonish me that I should waste no time in complying with the request contained in your letter of last evening; I shall therefore immediately avail myself of such opinions and facts as present themselves to me, in the discussion of the following questions:

1st. Has chlorine disinfecting powers?

2nd. What is its known mode of operation in certain cases and its probable mode in others?

3rd. How should it be applied for the purposes of disinfection?

1st. HAS CHLORINE DISINFECTING POWERS?

* "Les exhalaisons produites par les matieres animales en putrefaction, et meme par les individus attaqués de certaines maladies, sont toujours plus ou moins dangereuses a respirer. Pendant long-temps l'on a cherché vainement les moyens de les détruire. Enfin M. Guiton nous en a fait connaître un qui ne laisse rien a désirer. Il consiste a repandre, dans le lieu ou se forment ces exhalaisons, une certaine quantité de chlore gazeux."—*Thenard Traite de Chimie, vol. 4. p. 694.*

"Another important application of oxymuriatic acid (chlorine) gas, is that of destroying or neutralizing contagion."—*Dr. Murry's Chem. vol. 2, p. 565.*

"The remarkable power of chlorine, and its officinal compounds, chloride of lime and soda, in decomposing and destroying the fetid effluvia of animal and vegetable bodies in a state of putrefaction, has been so long known, has been verified in so many instances, and is susceptible of such direct demonstration, as to be beyond the cavils of medical pyrrhonism in its most wanton mood. That these effluvia are capable of making morbid impressions, upon the living body, is also placed beyond any reasonable doubt, not only by the sickness they instantly occasion, but by the many recorded cases of fevers of a putrid or low typhoid type, brought on by incautious exposure to masses of animal matter far advanced in putrefaction."—*Dr. Ure in the Jour. Roy. Ins. No. 4, p. 83.*

"Chlorine is by far the most powerful agent hitherto discovered to counteract contagion and all kinds of noxious effluvia and its sanative powers appear equally extraordinary."—*Dr. Silliman's Chem. vol. 2, p. 68.*

I have here quoted the opinions of eminently scientific men, at least three of whom are M. D's. and all of whom, it may be thought, do not deserve to be styled empyrics. But what weight ought these opinions to have in this discussion? Surely no more than those of any other person even much less eminent, unless they are better substantiated by facts. It was thought advisable, however, to quote them, since they may serve to correct any bias which entirely opposite opinions, proceeding from no higher source, may have occasioned.

*It is always more or less dangerous to respire those exhalations arising from animal substances in a state of putrefaction and even from individuals attacked with certain diseases. For a long time the means of destroying these were sought for in vain. At least M. Guiton made us acquainted with one which leaves us nothing to desire. It consists in evolving, in the place where these exhalations form, a certain quantity of chlorine gas.

But let us inquire what facts have so satisfactorily established, in the minds of our authors, men who have spent comparatively long lives in reflection and inquiry, the point that chlorine possesses those energetic disinfecting powers which they ascribed to it?

1st. FACTS OF PERSONS USING CHLORINE ENJOYING IMMUNITY FROM DISEASE, WHILE OTHERS NOT USING IT AND APPARENTLY EXPOSED TO THE SAME MORBIFIC OR INFECTIOUS AGENCIES, HAVE BEEN ATTACKED BY DISEASE.

The following is an extract from the letter of M. Parisot at the head of a medical expedition from France to Egypt and Syria, one of the objects of which was "to ascertain the effect of the chlorides on the infectious matter of the plague and on pestilential miasmata." The contagious nature of the plague was not doubted by him or those who commissioned him, it may be, for aught I know, by others.

—"We requested six sets of dresses (six shirts and six pair of drawers) in which persons had recently died of the plague; these, some of silk and some of cotton, were brought on the 2nd and put into the garden of the consul's house on the 3rd of June. On the 4th the state of the clothes was examined; they were foul with diseased matter and of a detestable odour. A woman (infected with the plague) steeped them in mere water to remove the excess of dirt, after which they were passed into a vessel containing a solution made by M. D'Arcet of six pounds of the chlorides in fifty lbs. of water, and there they remained 16 hours."

"On the 5th M. M. D'Arcet and Guilhau withdrew them from the solution, wrung them out and exposed them to the sun. The stains were weakened, but still very evident. At mid-day they were dry when each of us (there were six) took two pieces of the clothing and put them in contact with the skin. We put off this clothing on the 6th having worn it for eighteen hours. No one suffered; since then twenty-two days have elapsed and our health is the same."

D'Arcet, a colleague of Parisot, adds, that when "they wore the clothes next their skin they covered themselves up and took much exercise to excite perspiration. At this time from twelve to fifteen persons were dying per day—two hours after death a corpse was opened and examined; it was first

washed with chloride of lime and the hand kept continually bathed in the solution; the viscera were still warm. No injury to the examiners followed."

Inferences of Parisot "The consequence of all this is that we possess a means, 1st of disinfecting quickly and cheaply goods and clothing without the least injury to them. 2nd of reducing the disease to its own case and preventing it from producing a second or third case, and that by destroying the venom left in the first case which would otherwise perpetuate the evil; and not only can this be done with the plague but with the variola, rubeola, typhus, and even yellow fever.—*Ed. Jour. No. 13, N. S.*

"Two young medical men, desirous of examining a body which had been interred without dissection, in consequence of the prejudices of the relatives of the deceased, went in a very dark night to exhume it; but having mistaken the grave, laid open a coffin replete with such noisome corruption, that the gentlemen instantly sickened with the fœtor, were hardly able to go home, where they forthwith took to their bed, with symptoms of malignant fever and died. M. M. Orfila, Lessure, Gerdy and Hennelle, were employed about seven years ago, in Paris, to examine the body of an individual who was supposed to have been poisoned, and who had been dead and buried for nearly a month. Had they rashly proceeded to the inspection, they would most probably have fallen victims to their imprudence; the smell was intolerable and the body could hardly be approached; they had, therefore, recourse to the chloride of lime, sprinkling a solution of it over the putrid corpse, which produced, after a few aspersions, such wonderful effect, that the nauseous effluvia were instantly quenched, and the dissection was performed with comparative comfort."—*Dr. Ure, Sen. Jour. R. I. for Aug. 1831, p. 84.*

"Having performed several post mortem dissections of persons who have died from malignant fevers; dysentery with extensive ulceration of the mucous membrane of the large intestines, peritonitis with purulent effusion into the abdomen, hectic from suppuration, gangrene, &c. I have never suffered the slightest inconvenience. Yet these are the cases in which that peculiar animal poison is especially generated, which has occasionally proved fatal to the demonstrator of disease. I attribute the immunity I have enjoyed, in a great measure, to

my washing my hands immediately after each inspection, with the chlorosodaic liquor of Labarraque."

"A young gentleman, who acted as my colleague during part of last winter, but who did not adopt the above precaution, having imbibed, through a minute breach of surface on his little finger, a portion of this virus, was in a few hours thereafter attacked with acute inflammation of the absorbents of the arm, accompanied with high symptomatic fever, which confined him to his bed for many weeks, and required the most powerful antiphlogistic measures to subdue the inflammatory symptoms. I could cite instances of my predecessors having suffered from the same cause, but I deem it unnecessary as the fact is indisputable."—*Dr. Ure, Jun. House Surgeon of the Glasgow Royal Infirmary. Ibid. p. 83.*

"Several persons were bitten by a dog; some of these died with all the symptoms of hydrophobia, others were treated with chlorine; and though the symptoms returned once or twice on the early cessation of the remedy, yet they were vanquished by its continuance and a perfect cure effected."—*Dr. Previtali. Quart. Jour. vol. 12, p. 190.*

The following abstract from a letter by Mr. Dauvergne to M. Gay Lussac, giving a highly interesting illustration of the powers of chlorine, may with propriety be introduced under this head:

"Two drops of hydrocyanic (Prussic) acid were put into the end of a glass tube, and introduced into the lachrymal gland of a cat: contractions immediately came on, followed by strong tetanic convulsions, an abundant salivation took place, producing, through hard breathing, a thick white froth. The pulsations of the heart were quick, irregular and extensive, as if each were the last effort of life. Inspiration was difficult and painful; expiration frequent, prompt and forcible. Notwithstanding this desperate state of the animal, M. Simeon was induced, from his previous knowledge, to expect good effects from the use of chlorine, and therefore introduced a considerable quantity into the mouth; the salivation in consequence ceased; the respiration became easy; the circulation less forced and rapid. The animal now raised its head which before it could not do; put out its tongue and scented the chlorine as if it took pleasure in respiring a salutary and agreeable atmosphere. At the end of two hours, traces of the

event were scarcely visible.”—*Quart. Jour.* vol. 26, p. 421. *Vide also Jour. R. I.* No. 1, p. 188.—I might cite other facts under this head, but it is not deemed necessary.

2d. FACTS ILLUSTRATING THE POWERS OF CHLORINE IN DISINFECTING PLACES, WHERE ENDEMIC DISEASES HAD PREVAILED, OR WHERE THEY MOST PROBABLY WOULD HAVE PREVAILED, HAD IT NOT BEEN FOR THE AGENCY OF CHLORINE.

“I am acquainted with a very worthy company of Scotch bleachers, who have built several hundred cottages on their estate, for the use of their workmen and their families.”—“Whenever there is an appearance of fever in any one of these houses, one of the managers orders the whole family out of it—shuts up the house—having provided that every part of it may be completely filled with the chlorine gas, which quickly neutralizes or destroys all the putrid miasmata, and renders the habitation perfectly safe and wholesome.” For twenty years no fever had made any progress in that establishment.—*Parke’s Chem. Ess.* Vol. 2, p. 345.

“During the long period of thirty years that I have conducted this establishment, (where a great many tons of chloride of lime were for many years treated every week with sulphuric acid, in order to obtain a strong aqueous solution of chlorine) with a population of two or three thousand, including their families, I am not aware of a single case of disease that could be classed as contagious; and in many hundred cases in which I have recommended chlorine in the village, (Barrowfield) its good effects have been apparent in arresting the progress of the typhus and other fevers.”—*Mr. Rogers, Jour. R. I.* No. 4, p. 96.—“While typhus was prevalent in the neighborhood, none of the workmen employed in the manufacture of chloride of lime, were ever its victims.”—*Mr. White of Shawfield—ibid. ibid.*

James Corkindale, M. D. LL. D. physician to the goal at Glasgow, and celebrated for his skill in medical jurisprudence, writes regarding about twelve families, residing in the vicinity of works for the preparation of chloride of lime. “These persons have continued to reside there for various periods from two to twenty years. I examined the condition of these people, and made inquiries as the history of their health, during

their residence as detailed by themselves. I found that their condition, in this respect, was nearly the same as other persons of the same rank of life, in ordinary situations; but it was the uniform statement of the whole of them, that no person residing on these premises, had been affected with typhus at the different periods when that epidemic was very prevalent at Glasgow. It was evident, from inspection, that this immunity was not owing to superior cleanliness and ventilation, for the apartments were as dirty and as crowded as the ordinary habitations, where I know typhus had prevailed. The vapors from the works were various, but by far the most prominent was chlorine.—*Ibid.* 97.

“A letter from A. Chevalier to M. D’Arcet, (after the revolutionary struggle in July, 1830) informs the latter, that the writer in passing near the Morgue on the 30th, was forcibly struck with the putrid exhalations which issued from it, and which were very perceptible as far as the pont St. Michel. Fearing unpleasant consequences to the whole neighborhood, he sent one of his pupils immediately to the directors of the Morgue, to offer them, gratuitously, the use of as much chloride of lime as might be requisite to arrest the infection, which being accepted, and learning that they were about to remove, immediately about two hundred dead bodies that were heaped up in the Morgue, he proceeded, though without authority, to the place; prepared a large quantity of liquid chloride, and sprinkled it over the bodies, which, as they were moved, exhaled the most foetid odour. He persuaded the poor men who were employed in the work, though with some difficulty, to wash their hands every time they handled the bodies.—These, as they were taken to the boat, were well sprinkled, and portions of the dry powdered chloride were scattered in every place where it appeared necessary. These precautions, notwithstanding the mass of putrifying materials, completely overcame the exhalations, or these gave way to those of the chloride.”—*Quoted in Silliman’s Jour.* vol. 21, p. 149.

“The numerous and important applications that have been made of these two liquids, (chlorured compounds of Labarraque) in France, for the last three years, deserve the most earnest attention. By their aid, the purification of the tainted air in hospital wards, prisons, work-houses, lazarettos, ships,

sick chambers, closets, sewers, wells, drains, stables and manufactories, in which animal substances in a state of putrefaction are used, has been effected in the most satisfactory manner; and not only with greater ease, but in a much shorter period of time than by any other method previously employed. Subsequent experiments have shown that these liquids may also be used with great advantage in arresting mortification or gangrene in the living body; and, it is probable that further applications of the utmost interest may shortly be published.

“In the hands of the physician, whose duties call him to the bed-side of patients labouring under infectious or contagious disorders; in those of the anatomist, whose pathological inquiries expose him to much risk and inconvenience; to the magistrate who has the salubrity of large and crowded communities intrusted to his vigilance—the disinfecting liquids have already been of the most essential service, accomplishing their respective objects with a success that no other method previously devised had ever ensured. These are *facts* that no longer rest on the mere dictum of a single individual.”—*A. B. Granville, M. D. F. R. S. physician in ordinary to the duke of Clarence. Quart. Jour.* 22, p. 372.

“The cathedral of Dijon had been, for several years, infested with a febrile fomes or miasma, which occasioned fever in many of its pious visitants, and it had become, in consequence, nearly deserted as a place of worship. Being then (1794) professor of chemistry in the academy of Dijon, M. Guiton was naturally induced to exercise his science in expurgating the air of the church. He accordingly filled the whole capacity of the building with muriatic acid gas, (a compound of hydrogen and chlorine) disengaged from a mixture of salt and sulphuric acid, distributed in a number of stone-ware dishes. The doors and windows were kept close for two or three days, to prevent the dissipation of the acid fumes. At the end of this period a free ventilation was given, after which the church was found to be deprived of its unpleasant smell and unwholesome effluvia.” Notwithstanding the successful result of M. Guiton’s experiment, with muriatic acid, he afterwards strongly recommended the use of chlorine for disinfecting purposes, and contributed much to its introduction.—*Dr. Ure, Jour. R. I. No. 4, p. 85.*

"On the 11th of July last, the fleet destined for the invasion of Mexico, conveying, in addition to the usual complement of mariners, a large number of soldiers, was overtaken in the Gulf of Mexico by a violent tempest, which continued for several days. The severity of the storm rendered it necessary to remove the windsails, and to close, not only the ports of the lower gun deck, but likewise those of the main deck, and to place on the hatches. In this condition of the ships, with such a crowd of persons confined together, in the middle of summer, within the tropics, without fresh air, putrid fever and malignant dysentery soon made their appearance.—The air is described as possessing, in addition to a highly offensive effluvium, an acrid heat, burning to the skin, with a degree of density that arrested respiration and produced giddiness.

"At this moment of distress and anxiety for the safety of all on board, the chlorine was used with the most decided and happy effects. Twelve vessels, containing one ounce each of the chloride of lime, in solution with water, were suspended on the birth deck, four were placed on the orlop deck, and in the gun room. In the space of two hours, the atmosphere lost all its deleterious qualities, and became perfectly agreeable, leaving nothing perceptible but the smell of tar, which always exists more or less in ships. The solutions were renewed every twenty four hours; but the chloride undissolved at the bottom of the vessels was then sprinkled on the decks, and thrown into such vessels as it became necessary to cleanse.—During the whole of the campaign, which lasted three months and a half, the atmosphere was preserved in this pure state by the chlorine, to which all the surgeons unite in attributing the very few instances of death that occurred in the fleet, when there existed such fruitful sources of fatal disorders."—*Silliman's Jour.* Vol. 19, p. 165.

It seems to me that I need not farther accumulate facts under this head—that I need not speak in detail of numerous expurgations of infected penitentiaries, hospitals and ships—nor of the much diminished amount of sickness in prisons, on ship-board, and in unhealthy manufactories, at home and abroad, since chlorine has been habitually used in them. It seems to me that the number of experiments already detailed; the characters of the persons who made them, and the results

of those experiments, have rendered it unnecessary that "the use of chlorine" should, at present, be empirical—not founded in science, nor the result of deduction from observation.

3d. FACTS ILLUSTRATING THE SANATIVE POWERS OF CHLORINE, ITS ACTION UPON MORBID MATTER FROM WHICH ITS DISINFECTING POWERS MIGHT HAVE BEEN INFERRED.

"The chloride of soda has lately been most beneficially introduced into the materia medica. The chlorides arrest animal and vegetable decomposition. Chlorine acts chemically upon the morbid matter and resolves it into innocuous principles; the application of the chloride of soda in carbuncle, ulcers, gangrenous sores and mortification, and in cutaneous diseases, has been successful. It is used as a gargle in ulcerated sore throat."—*Silliman's Chem. vol. 2, p. 69.*

"Dr. Sacco of Milan, finding that two or three ounces of the solution of chlorine, might be drank at once without injury, and reasoning from its effect on infectious matter, administered it in cases of spotted fever, and found that in two or three days the effect was to reduce the disease to a simple fever, to shorten the period of its duration, and to lessen the diminution of strength, and other bad consequences that remain after the fever is removed. And from the constant good effect produced in these and similar cases, Dr. Sacco states his conviction, that it will be of the utmost service in the putrid fever, yellow fever, plague and all other contagious disorders."—*Quart. Jour. vol. 12, p. 190.*

"Dr. Brown employs chlorine, in solution, in cases of the scarlet fever, he says, with the utmost success. In the sore throat, sometimes accompanying the fever, it is more easily swallowed than mucilaginous drinks."—*Ibid. vol. 16, p. 395.*

"Prof. Ives successfully administered chloric ether in cases of severe paroxysms of pain in the chest, and difficulty of breathing, and of scarlet fever. He remarks that it is diffusible in its action like the other ethers, it possesses the peculiar properties of chlorine, and it has this advantage over other ethers, that it is always grateful."—*Silliman's Jour. vol. 21, p. 406.*

Now if there is ever a specific virus in the system, constituting or occasioning disease; and if the virus of the noxious exhalations therefrom is identical with or analogous to it, which may be thought highly probable, is it not fair to infer

that, if chlorine is found to destroy the virus in the system, it would also render innocuous its noxious exhalations?

I must confess, sir, that my reading on this subject has not been very extensive. I have not had access to many books which might have rendered me important instructions relating to this discussion; but I ask whether any man, free from prejudice, and willing to give the matter something more than a superficial examination, after having read the opinions with which this discussion commenced, and the three classes of facts which I have collated, with the authorities by which they are sanctioned, can doubt that chlorine possesses energetic disinfecting powers—that its use is not at present empirical—but *is founded in science, and is the result of deduction from observation?* I have not sought to prove that chlorine can destroy the particular infection, if it be infection, that causes the cholera, I am confident that I could have satisfied neither myself nor any one else had I so sought, but I have sought to convince all of what I firmly believe, that chlorine may be employed with great advantage as a disinfecting agent, in all cases where disagreeable or morbid exhalations arise from the decomposition of vegetable and animal substances, and that *at the present juncture it ought to be considered indispensable in and about every house in our populous cities.*

The following letter to Dr. Ure from M. d'Epinay, agent of the island of Mauritius, to the British government was not introduced under the first class of facts where it might properly have been referred, because I was desirous of collecting facts to prove the general rather than the particular disinfecting powers of chlorine, and because the facts detailed in the letter may be thought not to prove any thing conclusively.

I cannot refrain, however, from inserting it in this place. “I told you that in the Isle of France, during the cholera, we employed as a disinfector a mixture of oxide of manganese and muriatic acid, (materials by whose action chlorine is evolved) We provided small phials of it, which were carried about in all the infirmaries, and by the people who entered the hospitals. They were also carried about by the women and children; and it was remarked that none of those so protected by the disinfecting phials were attacked by the disease.”—*Jour. R. I. No. 4, p. 100.*

The following notices from the London Sun have just come to my hand and are deemed of the very highest moment :

“ We stated some time ago that in consequence of a letter from A. R. Raeburn, Esq. of St. Bernards, the board of health of Musselburgh, adopted the plan of fumigating the streets, lanes, alleys and houses there with chlorine raised from sea salt and manganese by means of sulphuric acid ; and it is worthy of remark, that from the commencement of this operation, the disease rapidly diminished in number of cases and in virulence, so that in eight days it had entirely ceased in Fisher’s row, and the instances of it have been very few even in the Musselburgh district. But what happened in Porto Bello is probably still more conclusive. The Cholera had just begun to rage in that village ; from the 17th to the 18th ult. there were seven deaths and several cases considered dangerous.— The board of health then adopted the plan of public and private fumigation, which was most thoroughly done, and the malady seems to have been subdued or rather extirpated in one day. Porto Bello has had no new cases since the 23d and no new deaths except one on the 25th.”

But the Cholera has been so unexpected in its arrival in certain places and so sudden in its disappearance from them, that these experiments may, to many, appear inconclusive.

2nd. WHAT IS ITS KNOWN MODE OF OPERATION IN CERTAIN CASES AND ITS PROBABLE MODE IN OTHERS ?

* “ Le chlore attaque presque toutes les substances vegetales.—L’action a lieu a la temperature ordinaire ; c’est toujours en s’emparant d’une partie de leur hydrogene qu’il decompose ces substances : il passe ainsi a l’etat d’acide hydrochlorique, et les transforme en d’autres matieres qui n’ont point encore ete examinees. Peut-etre au nombre de ces matieres doit-on placer l’acide carbonique, l’acide acetique ; peut-etre aussi sont-elles nouvelles.—Il est facile de concevoir, d’apres cela, pourquoi l’on emploie le chlore avec tant

*Chlorine acts upon nearly all vegetable substances. The action takes place at the ordinary temperature. It is always in combining with a part of their hydrogen that it decomposes these substances ; it thus passes to the state of muriatic acid, and changes them into other substances which have not yet been examined. Perhaps among the number of these substances we should place carbonic acid, acetic acid ; perhaps also they are new. It is easy to conceive, from this, how we employ chlorine with so great success for the decomposition of the putrid miasmata which sometimes become diffused through the air.

de succes—et pour decomposer les miasmes putrides qui se repandent quelquefois dans l'air.—*Thenard, Traite de Chimie tome 3d, pp. 579-80.*

“Mr. Faraday confined himself (in a lecture before the Royal Institution) to considerations purely chemical. Chlorine acts upon putrid or infectious miasmata, sometimes by the abstraction of hydrogen, with which it forms muriatic acid; sometimes by combining with and forming triple compounds with the carbon and hydrogen of the vapors; and sometimes, perhaps, by evolving oxygen which, in its nascent state, acts upon the effluvia; but in all cases it acts chemically, and converts that which is noxious into inoffensive substances.”—*Quar. Jour. vol. 22d, p. 461.*

“The phenomena of putrefactive fermentation seem to show that the fetor resides in certain hydrogenated compounds containing carbon, sulphur, phosphorus, azote, &c.; for gaseous matter of this kind is eventually disengaged in the larger cavities of the trunk, as well as in the cellular tissue causing a general intumescence. There is every probability, likewise, that the diffusible fomes of contagious disease resides in some analagous compounds, but of so subtle a nature as hitherto to have baffled every effort of chemistry to collect and analyze.”—*Dr. Ure, Jour. R. I. No. 5th, p. 85.*

Dr. Ure, doubtless, considered that the strong affinity of chlorine for hydrogen, and the change of the nature or properties of a compound resulting from a change in the proportion of its elements, were so generally known as to render it unnecessary that he should be particular in specifying the mode, in which chlorine acts as a disinfectant. You cannot but have marked the emphasis with which he asserts the probability that the fomes of contagious disease resides in certain compounds analagous to the hydrogenated compounds specified by him.—He knew that it is entirely unphilosophical to affirm that the principle of contagion is not a compound gas, in many respects such as chemists are accustomed to catch in their receivers.—It may be, for aught that is known, some compound of sulphur and hydrogen, or of carbon and hydrogen or of hydrogen and nitrogen, or of any other known or unknown elements, possessing extreme tenuity, and having its elements combined in different proportions and by different laws, from those of any known compound. The principle of contagion is, as yet, only

known to exist by its action upon the animal system, and its chemical constitution is only inferred from the well attested agency of chlorine in destroying it. Chemists as well as others are liable sometimes to deduce too general inferences from particular facts; but there have been so many facts illustrating the action of chlorine upon contagious or infectious matter, as to lead them to conclude, that most if not all virus of vegetable or animal origin contains hydrogen which can be abstracted by the action of sufficient free chlorine, and thus the virus destroyed. Whether it be always, or in what cases, it is practicable to administer the quantity requisite to destroy virus when in the system, are questions foreign to the present discussion. From what has now been said however, it is easy to conceive how chlorine acted when administered to those who gave symptoms of hydrophobia, and to the cat, in which it proved an antidote to Prussic acid. But however the truth or justness of inferences from well attested and well understood facts, employed in the explanation of other facts, may be disputed, the facts themselves, which these inferences were intended to explain, should not, on that account, be discredited.

The utility of many things has been accidentally discovered, and we have long availed ourselves of their use without having been able to explain the peculiar relation which they sustained to our necessities or conveniences, or what particular changes they effected in us, or in that which concerned us. It has not been so with chlorine. Occasions for its use have been pointed out, and the mode of its operation has been explained by science. There has been less blind experiment with it, than with, perhaps, any other agent that has contributed to our health and comfort.

It may be important to speak in this connexion of various other means often used for disinfection and to discriminate between the mode of their operation and that of chlorine. These are the kindling of fires, discharging of cannon and musketry, burning of sugar, tar, sulphur, the fumes of vinegar and camphor, &c. When the infected air occupies low and confined situations, where ventilation is difficult and imperfect the three first mentioned means may be employed perhaps with much advantage: not by destroying the infection, but by dissipating it—by creating currents in the air which would bear away some of the foul air, and introduce some that

is pure. In respect to the five last mentioned means, they could produce this effect only in a very slight degree and, there are no facts or analogies to render it probable that they destroy infection by acting chemically upon the matter of it. The only good effect which they can have, is to render fetid substances imperceptible to our sense of smelling, by themselves affecting it with greater pungency than the fetid gases. They serve to disguise, not to dissipate nor to destroy. And some of them are themselves positively deleterious. None of them should ever be depended upon where chlorine can be applied.

3rd. HOW SHOULD CHLORINE BE APPLIED FOR PURPOSES OF DISINFECTION ?

The most favorable mode of its application for these purposes, varies greatly, with the amount of infection and with the extent and numerous other circumstances of the place to be disinfected.

The following observations are from Mr. Faraday's account of a successful fumigation, with chlorine, which he gave to the general penitentiary, at Millbank, England.

"I was desirous for many reasons of obtaining a gradual and successive developement of the disinfecting agent, rather than a sudden and short one. The latter mode, though it would have filled the building at once, and probably very effectually, yet would have seriously incommoded the operators, and would also soon have disappeared in consequence of absorption by the limed walls, and from dissipation through apertures that would inevitably remain unclosed in different parts of the building: whilst the former mode, by continually supplying the disinfecting agent to the atmosphere of the place for a length of time, would enable it better to act on the bedding, clothing, and other articles left in the cells, and allow it also more perfectly to penetrate to every part of the building itself.

"The materials used were common salt, oxide of manganese in powder, and oil of vitriol. I found that a mixture of one part by weight of common salt and one part of oxide of manganese, when acted upon by two parts of oil of vitriol, previously mixed with one part (by weight) of water, and left till cold, produced the best results. Such a mixture made at the temperature of 60 deg. Fah. liberated no muriatic acid; but

in a few minutes began to evolve chlorine and continued to do so for four days. When examined on the fifth day and urged by heat, so as to cause the liberation of all the chlorine that could be afforded by it, only a small proportion was obtained. Such a mixture therefore may be considered as having liberated its chlorine gradually but perfectly, without the application of any extraneous heat, and it is therefore very proper for extensive fumigation.

“The vessels in which the mixture is to be made should be flat, and such as, being economical, are least acted upon by the chlorine or acid. Common red pans were used—better earthen ware would have been too expensive.

“Preparatory to the fumigation, a quantity of the salt was turned out, the lumps broken down by a mallet until the whole was in powder, and then an equal weight of the oxide of manganese added, and the whole well mixed. The acid and water were mixed in a wooden tub, the water being put in first, then about half the acid added, stirring at the same time.—When the heat produced had been dissipated, which happened in a few hours, the rest of the acid was added, stirring as before, and the whole left till cold. The men used measures in mixing the acid and water; and were told to take rather less of water than of the acid, 9 measures to 10 being nearly the quantities required. Any slight departure from these proportions would be of no consequence. The pans were then charged with the mixed manganese and salt, and with the dilute oil of vitriol, so as to form the mixture first described, and were distributed at proper intervals along the galleries, &c. doors, windows, key-holes, &c. having been cautiously closed. The mixture was well stirred with a stick, and left to itself. This was done without inconvenience to the operators, except when the dilute acid was applied, before it had cooled, to the mixture of salt and manganese; there was abundant time to go from pan to pan and to close the various galleries in succession.

“The whole quantity of materials used was 700 lbs. of common salt, 700 lbs. of oxide of manganese, and 1400 lbs. of oil of vitriol. The space requiring fumigation amounted to nearly 2,000,000 cubical feet, and the surface of the walls, floors, ceilings, &c. exclusive of furniture, bedding, &c. was about 1,200,000 square feet. This surface was principally stone and brick, most of which had been lime washed—the

means employed were applied, to an extent probably far beyond that requisite to the destruction of any miasmata that might be within the penitentiary. I should consider from one half to one fourth of the chlorine evolved quite sufficient for any of the usual cases where fumigation is required.”—*Quart. Jour.* vol. 18, pp. 92-5.

This mode of applying chlorine is the most economical and the most favorable in disinfecting lanes and alleys in cities, and public and private buildings when they are not occupied; the amount of materials employed always bearing a proper relation to the extent and condition of the place to be disinfected. It may often be desirable to have a more prompt effect or to have a fumigation completed in less time than was employed by Mr. Faraday: in such cases the process may be much hastened by the application of heat to the vessels containing the materials.

But there are many places, which require to be disinfected, to which this kind of fumigation cannot be applied. There is need, therefore, of further instructions and I here subjoin some given by Dr. Ure, relative to this topic.

“As gaseous chlorine, in the state in which it is evolved from muriatic acid and manganese, has been thought to be too concentrated for diffusing, in apartments occupied by the sick, recourse has been had in a variety of cases, to the exhalations that spontaneously arise from chloride of lime, exposed in an extensive surface, either in its pulverulent form or dissolved in water. It is true, indeed, that under both of these forms the chloride exhales its peculiar odour, but it gives out no appreciable or operative portion of the gas.—Nothing, therefore, can exceed, in absurdity, the fashionable nostrum for disinfecting apartments, *charged with contagious fomes*, by placing in them one or more saucers filled with the chloride of lime.

“It has been supposed that the carbonic acid present in the air, displaces the chlorine from the lime, but after passing a current of this gas (carbonic acid) for a whole day, through the chloride diffused in tepid water, I found the liquid still to possess the power of discharging the colour very readily from litmus paper.—To pretend, therefore, to suffocate the hydra of contagion by subjecting it to the simple smell of chloride of lime in a saucer, is just such a mockery as it would be to appease the famished stomach by the smell of the cook

shop. The subtle effluvia of a pestilence must be combated by more energetic means, they must be environed with an atmosphere of chlorine adequate to effect their destruction. Every thing short of this consummation is paltering with the safety, not of a few individuals, but possibly of a nation. *Whenever chlorine has failed to extinguish infectious fomes, the operator, and not the chemical agent itself, has been in fault.*

“An apartment may be conveniently disinfected by placing on a shelf or support near the ceiling a small basin or pipkin, containing chloride of lime, having set over it a glass or earthen-ware funnel with muriatic acid, diluted with about its weight of water; the beak of the funnel being *partially closed with a cork so that the acid may drop slowly down on the chloride.*—Eight ounces of good chloride thus treated with ten ounces of muriatic acid, will suffice to fumigate and sweeten the air of a common sized chamber. *In applying chlorine gas to apartments, we should always bear in mind, that it is one of the heaviest of elastic fluids, and therefore it tends to occupy the lower region in preference to the upper.*”

Dr. Ure's instructions were given under the apprehension of a visit from the cholera in Scotland, and probably on that account he was more solicitous to prevent people from trusting to the exhalations that spontaneously arise from the chloride of lime, than he otherwise would have been. But altho' his language, concerning the inadequacy, of those exhalations, to the purposes of disinfection, may be rather too strong to be sustained by all facts; (vide the account of the disinfection of the ship, *p.* 11) yet important hints should be taken from it, relative to the degree of concentration, in which chlorine may safely be used and sometimes, perhaps, must be used to be effectual.

It is hardly necessary to remind those who have charge of sick chambers, that it may sometimes be important, to have the atmosphere of an apartment continually more or less impregnated with chlorine; and that, therefore, caution should be observed to renew from time to time, as it may be needed, a supply of the materials for evolving chlorine. As the proper frequency of renewal will vary with the kind of materials employed, and of infection to be destroyed, of course no general rule can be given.

Muriatic acid may not always be at hand when it is de-

sirable to disengage chlorine from the chloride; in such cases, and, indeed, in all ordinary cases, vinegar may be substituted for it, and disinfection effected, in the following manner:

For an apartment of ordinary size, dissolve half an ounce of dry chloride of lime in a gill of water, add half a gill of good vinegar, stir well the mixture, place it in a shallow vessel, (a saucer or a soup plate) situated near the ceiling of the room.

If the apartment be large, two or more vessels (according to the size of the apartment) supplied in this way, should be arranged in different parts of it.

It is not thought advisable to make this mixture even in bottles, before it needs to be used.

Attendants upon the sick should sprinkle some of the mixture in vessels containing impurities, and on the cloths which may be used to cover them.

When there is no apprehension of danger from contagion, and the sole object is to destroy fetid gases, a bare solution of chloride of lime in water, will often be found to effect the object.

In such cases, dissolve half an ounce of the chloride of lime in about three pints of water and occasionally sprinkle the mixture around the apartment, and in the vessels as before directed.

When it is desirable to destroy the effluvia from drains, sewers, &c. or to purify the water of a cistern—dissolve about eight ounces of the chloride of lime in a pail full of water, and disperse it into them. *Repeat the operation until the object is effected.* Advantage may often be derived from scattering, into the place to be purified, a small quantity of hay or straw, and from sprinkling the solution over it.

It may be well to suggest to those who wish to keep the chloride of lime in their families, that it is important to preserve it in well stopped bottles or jars; since, when exposed to the air, "it rapidly passes into a deliquescent paste, consisting of muriate of lime and lime with an obscure displacement of oxygen," and its disinfecting purposes are thus destroyed.

If persons have to pass through lanes, or into infirmaries or hospitals, where great danger is to be apprehended from infection, they are advised to carry about them disinfecting phials

of the kind mentioned by D'Epinay, which may be prepared in the following manner :

Take phials of a convenient size (say ounce phials) having glass stoppers not very accurately ground; put into them about a tea spoon full of powdered oxide of manganese and about twice as much strong muriatic acid. The materials having been mixed by shaking the phials, will immediately begin to evolve chlorine, which will slowly escape between the stopper and the phial.

The directions and hints that have now been given, are thought to be sufficiently full and particular. When persons have become acquainted with the nature and use of chlorine, applied agreeably to those directions, any change in the mode of applying it, rendered necessary by peculiar circumstances, will readily suggest itself.

I should close this communication here, were it not to be feared, that, after all that has been written concerning the disinfecting powers of chlorine, persons may be apprehensive lest injury should result to the sick from the use of chlorine, and therefore refrain from using it.

On this topic it might be sufficient, to refer to what has been said relative to the health of those engaged in the preparation of chloride of lime, (vide p. 8) and to state that the respiration of dilute chlorine gas has been followed with success in cases of diseased lungs. But certain remarks of Dr. Ure are so apposite to this place, that I shall venture to insert them :

“ But I shall be asked, whether chlorine gas can be diffused through the air of a chamber without injuring the lungs of living beings, as well as the furniture and goods? I answer yes, when it is distributed on philosophical principles.— But I might ask the medical practitioner, in return, whether the corrosive sulphuric and nitric acids, may be administered internally? Yes, he would be ready to reply, when sufficiently diluted; and the same answer will serve for chlorine. I have been a frequent inmate of manufactories of chloride of lime on the greatest scale, and I have occasionally found the atmosphere, in certain departments of the works, to be impregnated, in a sensible degree, with chlorine gas. Moist litmus paper would have speedily lost its colour in such an atmosphere, although dyed woollen and calico stuffs, in the dry

state, suffered no perceptible change. The workmen who habitually respired this chlorified air, experienced no evil effects on their health, nor, indeed, any inconvenience at all, unless an accident befel some joint of their apparatus. These facts prove the safety of immersion in chlorine largely diluted with air, yet still strong enough to blanch moist litmus paper, which may be regarded as a satisfactory criterion of its activity when directed against contagion."—*Jour. R. I. No. 4, p. 88.*

Hoping that this very hastily prepared communication, may be of service to the public, and meet with your approbation, I subscribe myself,

Very respectfully,

Yours, &c.

C. AVERILL.

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